Massachusetts "Stretch" Energy Code

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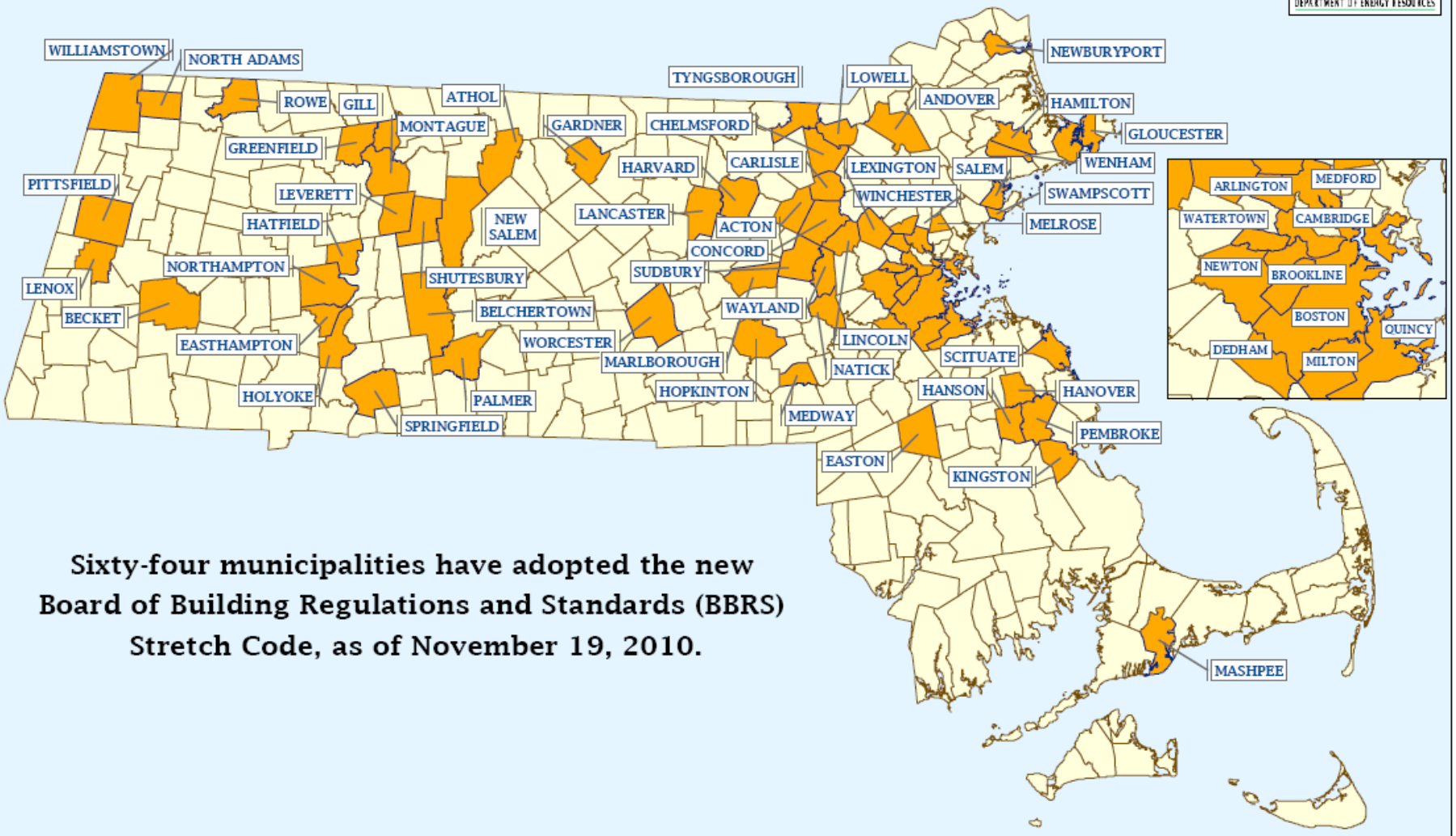
Stretch Code Adoption, by Community



Sixty-four municipalities have adopted the new Board of Building Regulations and Standards (BBRS) Stretch Code, as of November 19, 2010.

Mass. Building Code

- Uniform State-Wide Code in place since ’75

  Board of Building Regulation and Standards (BBRS) oversees the code; changes, appeals, etc.

- Enforcement by municipal building officials

- Scope, including but not limited to:
  - Fire Protection
  - Structure
  - HVAC
  - Plumbing, Electrical
  - Energy Conservation

What affects energy use?

- Size of building (external surface area)
- Air leakage – through holes in attic, walls, basement ceiling, heat/AC ducts and pipes
- Heat transfer through solid materials – can reduce with insulation
- Efficiency of equipment: heating and cooling systems, appliances, lighting

New Mass. Base Code

- Green Communities Act (2008) requires that Mass. adopt the latest version of the International Energy Efficiency Code (IECC) within one year of publication

- 2009 IECC became mandatory July 1, 2010

- For commercial buildings, IECC is similar to ASHRAE 90.1 standard

Residential stretch code based on ‘Energy Star’

- Proven cost-effective program
  - 1/3 of new construction in MA in 2009
- Builder incentives/rebates
  - $650/home for 30% better than reference home
  - Further rebates on appliances, heating and cooling, lighting, etc.
- Builder training and materials
- $650 subsidy for HERS raters

ENERGY STAR HOMES

Residential New Construction

- Performance only ‘stretch’ option
  - Uses Home Energy Rating System (HERS)
  - 70 or less < 3,000 sq ft.
  - 65 or less > 3,000 sq ft.
- Requires a certified HERS rater
  - Review building plans
  - Check insulation installation
  - Blower-door and duct testing

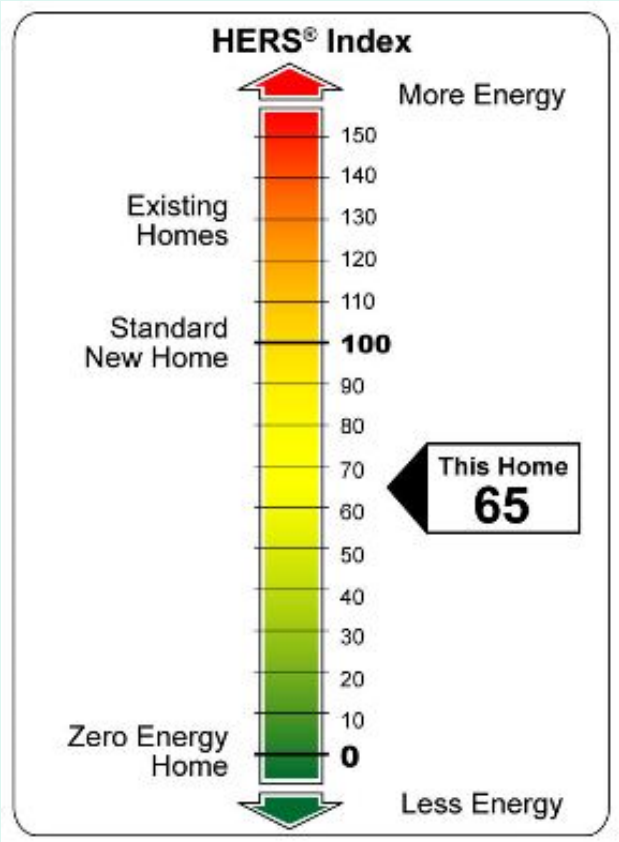
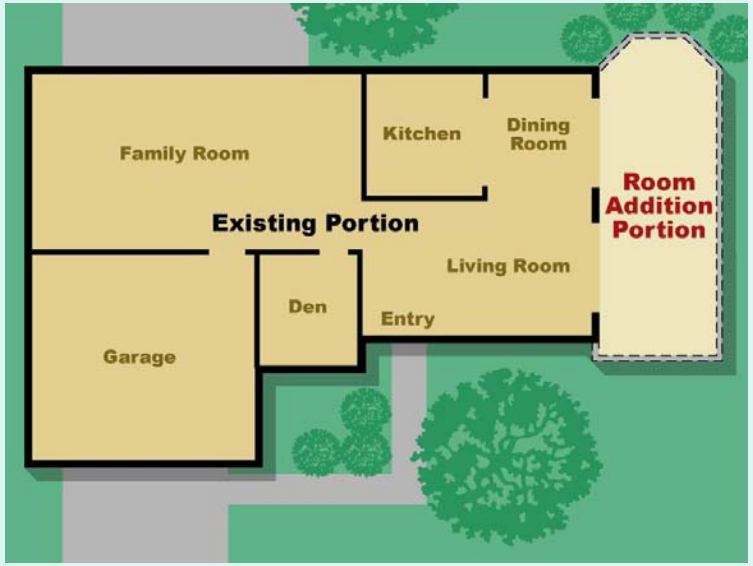


Image source: www.lexingtoninfrared.com/hers-ratings.php

Home Additions – 2 options

- HERS index on just addition or whole house
  - 70 or less < 3,000 sq ft.
  - 65 or less > 3,000 sq ft.



- Prescriptive Path
  - Energy Star Windows
  - Tighter ducts (4CFM vs. 8CFM baseline per 100sq ft)
  - Base Code insulation and envelope (IECC 2009)
  - Thermal Bypass Checklist

Home Renovations – 2 options

- Looser HERS rating than new buildings and additions
  - Easier HERS index requirement (mostly relevant for gut-renovations)
  - 85 or less < 2,000 sq ft.
  - 80 or less > 2,000 sq ft.

- Prescriptive Path
  - Same as for additions
  - Energy Star Windows
  - IECC 2009 envelope & Thermal bypass checklist

Single-family home, HERS 70 – one example, could do other ways

- Ceiling insulation, R38 Grade 1 (vs. Grade 2)
- Heating system, 94% AFUE efficiency
- Water heating, 62% EF efficiency
- Heating/AC duct leakage, 6% (vs. 8%)
- Air leakage - 5 air changes/hour at 50 Pascals pressure (vs. 7 changes)
- 80% efficient lighting (fluorescent)
- Exhaust-only ventilation

Baseline Home (2,672 sf)	
	Stretch Code - with ENERGY STAR
HERS Index Modeled in REM/Rate	**70**
Improvement Costs	$ 2,155
HERS Rater Fee[1]	$ 900
HERS Rater reimbursement[2]	- $ 650
ENERGY STAR Incentive[3]	- $ 650
Net Improvement Costs	$1,755
Mortgage Interest Rate	6%
Loan Term (Years)	30
Annual Incremental Mortgage Payment	$ 127
Annual Energy Costs[6]	$ 3,454
Annual Energy Savings from Baseline	$ 516
Annual Cash Flow Gain	**$ 389**

Large Home: 4,462 sq. ft.

	IECC 2009 Code	Stretch Code - with ENERGY STAR[4,5] -
HERS Index Modeled in REM/Rate	**92**	**65**
Improvement Measures (changes relative to Basecase)	- Unconditioned basement - Floor, R30 - Walls, R21 - Ceiling, R38 G2 - Heating, 80 AFUE - Cooling, 13 SEER - Water Heating, .59 EF - Duct leakage, 8% - Infiltration, 7 ACH50 - Efficient lighting, 50%	- Ceiling, R60 G1 - Heating, 94 AFUE - Water Heating, .62 EF - Duct Leakage, 6% - Infiltration, 3 ACH50 - Efficient Lighting, 90% - Exhaust Only Ventilation
Improvement Costs		$ 5,576
HERS Rater Fee[1]		$ 700
HERS Rater reimbursement[2]		$ (700)
ENERGY STAR Incentive[3]		$ (750)
Total Improvement Costs		$ 4,826
Mortgage Interest Rate		6%
Loan Term (Years)		30
Annual Incremental Mortgage Payment		$ 351
Annual Energy Costs[6]	$ 6,510	$ 5,055
Annual Energy Savings from Baseline		$ 1,455
Annual Cash Flow	**$ -**	**$ 1,104**

Gut Rehab of Triple-Decker

	IECC 2009 Code	Stretch Code
HERS Index Modeled in REM/Rate	**86**	**85**
Improvement Measures (changes relative to Basecase)	- Conditioned basement - Foundation Walls, R13 - Walls, R13 - Ceiling, R38 G2 - Heating, 80 AFUE - Water Heating, .59 EF - Infiltration, 7 ACH50 - Efficient lighting, 50%	- Infiltration, 6.75 ACH50 - Efficient Lighting, 75% - Exhaust Only Ventilation
Improvement Costs		$ 655
HERS Rater Fee[1]		$ 700
Total Improvement Costs		$ 1,355
Mortgage Interest Rate		6%
Loan Term (Years)		30
Annual Incremental Mortgage Payment		$ 98
Annual Energy Costs[2]	$ 8,091	$ 7,956
Annual Energy Savings from Baseline		$ 135
Annual Cash Flow	**$ -**	**$ 37**

COMMERCIAL STRETCH CODE

Commercial Stretch Code Requirements

(new construction only: renovations, < 5,000 ft2, and specialty buildings exempt)

Building category	Definition	Requirements based on energy performance (can do prescriptive instead where shown)	Alternative "prescriptive" requirement – specific efficiency measures
Large commercial and large residential multi-family	Commercial above 100,000 ft2; residential 4 stories or more and 100,000 ft2	Energy use 20% below ASHRAE 90.1 2007, determined by modeling	None
Medium commercial and residential multi-family	Commercial 5,000 to 100,000 ft2, residential 4 stories or more and below 100,000 ft2	Energy use 20% below ASHRAE 90.1 2007, determined by modeling	IECC 2009 with NBI Core performance: improved air sealing, insulation, lighting, etc.

Fidelity Bank
Corporate Office and Branch Case Study
Leominster, MA

Advanced Building Features

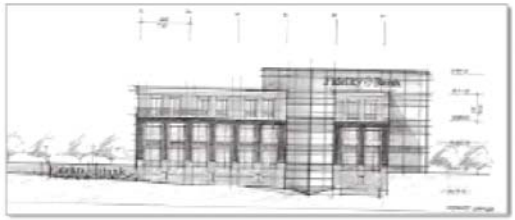
- High Efficiency T-5 Pendant Lighting
- Lighting Control Efficiency
- Reduced Lighting Power Density
- Efficient Site Lighting
- Additional Wall Insulation
- High Performance Glazing
- Efficient VAV RTU's, with ECM Motors
- Demand Control Ventilation
- Part Load HVAC Efficiency Enhancements

Funded Utility Services Support

- Early Life Cycle Cost Analysis
- Integrated Design Team Approach
- Commissioning

Project Description

The 47,000 SF Fidelity Bank Corporate Office and Branch was constructed as a design-build project in Leominster, MA. The four story building will provide office space plus a ground floor branch bank office. This project is acclaimed for its highly successful implementation of the national Advanced Buildings program. The project demonstrates the validity of the Advanced Buildings program assertions. The guideline cost effectively delivered even more than the expected 20% to 30% reduction in annual energy costs compared to a code based design.



Envelope Improvements

- Walls: Added 3-1/2" batt insulation to planned 2" rigid.
- Glazing:
  - Upgrade U value from 0.42 to 0.31
  - Upgrade SHGC from 0.50 to 0.30
- Projected envelope savings: $1,500

Project Team

Owner:
Fidelity Bank
Project Management:
Habitat Advisory Group

Commercial Case Study

Fidelity Bank, Leominster

- Additional cost for upgrades $100,600
- Annual energy savings $ 27,600
- Incentives from NGRID $ 66,600
- Net cost to owner before energy savings $ 34,000
- Payback period 1 year

Stretch Code – a great deal!

- Cuts energy use – helps energy security, cuts costs, reduces greenhouse gas emissions
- Increase in building cost is small
- If cost put in mortgage, energy savings immediately exceed annual costs
- Little change for renovations, additions
- Small commercial, and comm. renovations exempt
- Utility subsidies pay for much of cost for both residential and commercial

Extra Slides
(don’t expect to use)

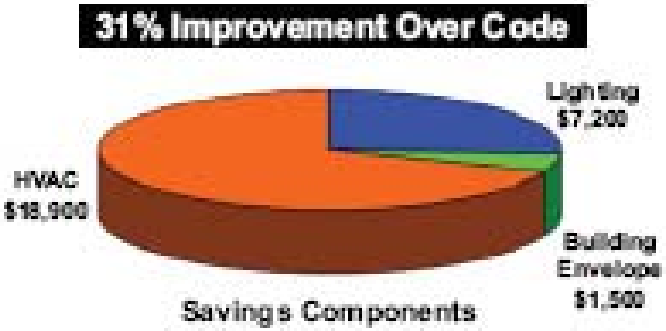
High Performance Building Design Uses 31% Less Energy

Savings Projection

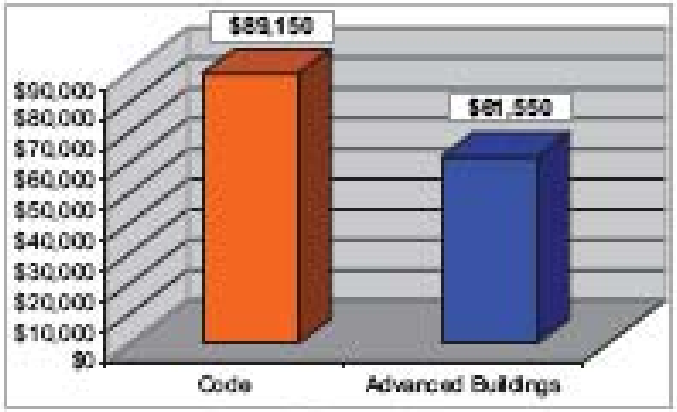
Annual Energy Savings:	$ 27,600
Additional Cost for Upgrades:	$100,622
Utility Incentives:	- $ 66,587
Net Owner Costs:	$ 34,035

Payback with Incentives: 1.2 years ROI: 83%

Payback without Incentives: 3.7 years ROI: 27%



Savings Components
($27,600 annual savings)



Annual Energy Costs

Lighting Savings Summary

The lighting layout consisted mainly of T-5 pendants in open office areas, and the latest generation of recessed T-5 fixtures in the remaining areas.

Projected Lighting Savings: $7,200

	Mass Energy Code	Advanced Buildings Criteria	Final Design	% Reduction
Lighting Power Density	1.34 w/SF	0.96 w/SF	0.86 w/SF	36%

Improved lighting quality while using <u>less</u> energy!

Building category	Definition	Requirements based on energy performance (can do prescriptive instead where shown)	Alternative "prescriptive" requirement – specific efficiency measures	Source, comments	Benefit-cost modeling results
New residential	Single-family, multi-family of 3 stories or less	HERS index 65 above 3,000 ft2, 70 below 3,000 ft2, certified by HERS rater; follow Energy Star thermal bypass checklist	None	HERS rating = energy use as % of use under IECC code. Current Mass. code ~ HERS 99; soon-to-be-adopted IECC 2009 ~ HERS 92	Sample 3 bedroom home, estimate $837/year savings ($8,103 extra construction cost = $527/year higher mortgage, but save $1,364/year energy costs)
Residential additions	Expansions of existing living space	HERS 65 over 3,000 ft2, HERS 70 below 3,000 ft2; certified by HERS rater (or can choose prescriptive option at right)	Prescriptive option of Energy Star Homes program - same as residential rehab below		3-bed home, estimate $40/year savings ($10,168 extra construction cost = $661/year, but energy costs $701/year lower)
Major residential rehab/ alterations	Major alterations as in existing code – excludes storm windows, reroofing, doors, etc.	HERS 80 over 2,000 ft2, HERS 85 under 2,000 ft2; certified by HERS rater (or prescriptive option)	Prescriptive option of Energy Star Homes program; insulation equal to IECC 2009 for climate zone 5	Quality air-sealing and insulation, EnergyStar windows	
Large commercial and large residential multi-family	Commercial above 100,000 ft2; residential 4 stories or more and 100,000 ft2	Energy use 20% below ASHRAE 90.1 2007, determined by modeling	None	DOE, NGRID modeling show energy savings greater than 20%	
Medium commercial and residential multi-family	Commercial 5,000 to 100,000 ft2, residential 4 stories or more and below 100,000 ft2	Energy use 20% below ASHRAE 90.1 2007, determined by modeling	IECC 2009 with NBI Core performance: improved air sealing, insulation, lighting, etc.	Prescriptive based on New Buildings Institute program; used by utilities now for incentive programs	NGRID, NSTAR case studies. Example – 60,000 ft2 office bldg., $91,000 extra cost, $29,500 annual energy savings; and $63,100 NGRID rebate
Small commercial	Below 5,000 ft2	Exempt	Exempt		
Specialty commercial	Supermarkets, labs, warehouses below 40,000 ft2	Exempt	Exempt	Other specialty buildings can apply for waiver	
Commercial alterations		Exempt	Exempt		

Efficiency steps to reach HERS 60

- Conditioned basement (heat/AC)
- Foundation walls R10 insulation
- Above-grade walls R22 insulation
- Energy Star windows- U-factor 0.33 (heat loss rating)
- Attic ceiling R38 cellulose insulation
- Slope ceiling R32 cellulose insulation
- Air leakage: 4 air changes/hour at 50 Pascals pressure (created by high-power fan)
- Natural gas furnace 0.94 efficiency
- Central Air Conditioner - 3 ton 15 SEER (efficiency)
- Domestic Hot Water - 0.62 efficiency natural gas tank
- Programmable thermostat
- 75 percent fluorescent lighting

Gut Rehab of Triple-Decker with air-sealing, heat recovery ventilation

	IECC 2009 Code	Stretch Code - ERV + Air Seal -
HERS Index Modeled in REM/Rate	**86**	**78**
Improvement Measures (changes relative to Basecase)	- Conditioned basement - Foundation Walls, R13 - Walls, R13 - Ceiling, R38 G2 - Heating, 80 AFUE - Water Heating, .59 EF - Infiltration, 7 ACH50 - Efficient lighting, 50%	- Infiltration, 4 ACH50 - Efficient Lighting, 75% - Energy Recovery Ventilation
Improvement Costs		$ 8,873
HERS Rater Fee[1]		$ 700
Total Improvement Costs		$ 9,573
Mortgage Interest Rate		6%
Loan Term (Years)		30
Annual Incremental Mortgage Payment		$ 695
Annual Energy Costs[2]	$ 8,091	$ 7,342
Annual Energy Savings from Baseline		$ 749
Annual Cash Flow	**$ -**	**$ 54**